DOCUMENT RESUME

ED 206 785 UD 021 656

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TITLE An Investigation of Cross-Cultural Cognitive Styles among Traditional and Assimilated Communities of Polynesians and Asian-Americans: A Pilot Study.
PUB DATE 23 Apr 81
NOTE 31p.: Not available in paper copy due to authors' restriction. Some tables may be marginally legible due to reproduction quality of original document. Paper presented at the Annual Convention of the National Association for Asian and Pacific American Education (3rd, Honolulu, HI, April 23, 1981).

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Asian Americans; *Cognitive Measurement; *Cognitive Style; *Cross Cultural Studies; *Cultural Differences; Elementary Education; Hawaiians; *Learning Modalities; Samoan Americans; Whites
IDENTIFIERS *Hill Cognitive Style Mapping Inventory

ABSTRACT

This study investigated the effect of culture on the cognitive styles of Polynesian Asian, and Caucasian Americans in a multicultural school setting. The study attempted to test the Hill scales of cognitive development to determine if they would be a valid predictor of individual cognitive styles. In addition, the investigation tested the popular hypothesis, derived from previous studies on cognitive styles, that students come to school equipped with preferred modes of learning that are the result of the child's cultural milieu, and the teaching style of the mother. The participants in this study came from three sixth grade classes in an Hawaiian school, and were nearly equally distributed with regard to sex. Data were collected by having students respond to Hill's Cognitive Style Mapping Questionnaire. The data showed that sixth graders in a multicultural setting in Hawaii tend to demonstrate differing cognitive styles which they bring to school as a result of each child's dominant family culture, and the Hill scales seem to discriminate these differences along cultural lines. (Author/APM)

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ED206785

AN INVESTIGATION OF CROSS-CULTURAL COGNITIVE STYLES AMONG TRADITIONAL AND ASSIMILATED COMMUNITIES OF POLYNESIANS AND ASIAN-AMERICANS: A PILOT STUDY

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Presentation at the Third Annual Convention of the National Association for Asian and Pacific American Education
Honolulu, Hawaii
April 23, 1981

UD021656

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INTRODUCTION

Overview of the Problem

In the past decade, an unprecedented number of persons of high-school age and above have entered post-secondary education. Asian and Polynesian-Americans, members of minority groups on the Mainland, and individuals from the Pacific Basin, have enrolled in universities and community colleges in ever-increasing numbers. The increased diversity, and especially the cross-cultural nature of this student body has changed the climate for learning which is being brought to educational institutions.

In contrast to the great change in student body characteristics, academia in general has responded with only a few changes in instructional procedures to do its part in creating a more positive climate in which learning may occur. Education--seen as a process where learning is dispensed by the instructor and received by the student--charges traditionally ahead without taking time to identify individual differences among students. Even less time is spent emphasizing those differences and doing something which seeks to accomodate those differences within the learning environment.

Attrition, that dirty word that strikes fear into every administrator, is a problem especially apparent among student populations whose numbers are cross-cultural in nature, from low socio-economic backgrounds, or members of minority groups. The "mysteries" of our complex technological society unfold rather slowly for some students when no attempt is made to analyze how they differ in cognitive capabilities from others.

Educators recognize the importance of demographic differences such as sex, race, ethnic background and social class, but other important differences exit which must be attended to. When demographic variables are held constant, a learner's typical modes of perceiving, thinking, remembering and problem solving can be studied. Taken together, these learning modes are commonly called a person's cognitive styles.

The term "cognitive style" has existed in psychological literature for the last thirty years. Psychologists such as Ausubel (1968) and Messick (1969) see cognitive styles as enduring individual differences. McKenny and Keen (1973) have defined cognitive style as that which ". . . reflects an individual's propensity and preference for coming to terms with the data-stimuli of his environment through particular modes of thinking that are partly conscious strategies and partly unconscious habits." Cognitive styles appear to have some of the same properties as abilities; but according to Kogan (1971), "a difference in emphasis should be noted: abilities concern level of skill--the more and less of performance--whereas cognitive styles give greater weight to the manner and form of cognition.

Cognition style research developed out of studies of perception. While much early work on perception was done in an effort to determine what general factors operate in all persons as they process environmental stimuli, researchers such as Gardner (1953) and Witkin, et al. (1962) were struck by the fact that there were clear differences among individuals in their modes of perception. Although it was tempting to try to tie these differences to differences in intelligence (which had already been widely studied both in France and the United States), these researchers became convinced that they were dealing with a separate phenomenon that was quite independent of intelligence and other abilities.

Most of the research on cognitive style has been motivated by work from three major groups: Witkin and his associates first at Brooklyn College and later at Educational Testing Service; Holzman, Gardner, and their associates at the Menninger Foundation; and Kagan and his associates at the Fels Institute. Sperry (1972) summarizes the early work of these three groups as follows:

1. Just after World War II, Witkin isolated a perceptual trait, "field dependence/independence" which was later generalized to include cognitive functions. Further research suggested that this trait appeared in many aspects of an individual's personality, all of which reflected his level of psychological differentiation.

2. Holzman and Gardner identified a number of "control principles": leveling and sharpening, equivalence range, tolerance for unrealistic experiences, flexible vs. restricted control, and differentiation vs. undifferentiation. The theme of their research was that "personality organization, called cognitive control, accounts for an individual's mode of perceiving, remembering, and thinking." These researchers view cognitive style as a "composite of cognitive controls" (Sperry, 1972, p. 96).

3. Kagan focused his research on analytic thinking. He came to the conclusion that analytic and nonanalytic style are related to two major variables: reflectivity and impulsivity.

Follow-on research investigated the various dimensions of cognitive style as defined by the three groups. These efforts resulted in the formulation of three models of cognitive style.

The Messick Cognitive Dimensions Model

Samuel Messick (1970) lists and describes nine separate bi-polar cognitive dimensions that have been the object of systematic theoretical and empirical examination by various researchers. "These dimensions have been conceptualized as cognitive styles which represent a person's typical modes of perceiving, remembering, thinking and problem solving."

1. Field independence vs. field dependence: An analytical vs. a global way of perceiving.

2. Scanning: Differences in the extensiveness and intensity of attention deployment.

3. Breadth of categorizing: Consistent preferences for broad inclusiveness as opposed to narrow exclusiveness in establishing the acceptable range for specified categories.

4. Conceptualizing Style: The tendency to conceive of things as having many properties as opposed to few.

5. Cognitive complexity vs. simplicity: Individual differences in the tendency to construe the world, particularly the world of social behavior, in a multidimensional and discriminating way.

6. Reflectiveness vs. impulsivity: Individual consistencies in the speed with which hypotheses are selected and information processed.

7. Leveling vs. sharpening: Reliable individual variations in assimilation in memory.

8. Constricted vs. flexible control: Individual differences in susceptibility to distraction and cognitive interference in tasks containing conflicting cues.

9. Tolerance for unrealistic experiences: A dimension of differential willingness to accept perceptions at variance with conventional experience.

In addition to these nine dimensions there is a risk-taking vs. cautiousness dimension which has been identified by Kogan (1971).

The McKenney Model

The cognitive style model developed by Jim McKenney and his associates at Harvard is based on certain assumptions about the nature of human information processing activities. In their definition, individuals develop both conscious strategies and unconscious habits for taking in information and assessing that information in order to solve problems and make decisions. Rather than being bi-polar like each of the dimensions listed in the previous

model, this model includes the two dimensions affecting the different aspects of human information processing; information gathering and information processing.

While researchers in cognitive styles have been postulating models whose application to education and business could improve learning outcomes, the former president of a large community college in the Detroit, Michigan, area was busy creating his own model based on a composite of research findings from Witkin, Bruner and Guilford. In the late 1960's, Joseph E. Hill developed what he called the Educational Sciences. Cognitive style was part of the conceptual framework underlying the applied field known as education. In the Hill model, cognitive style is number five of the seven educational sciences. For Hill (1970), cognitive style represented the manner in which an individual seeks meaning from his environment. As he explained his model:

> "The concept of cognitive style is expressed as, what mathematics call, a Cartesian product of sets." In this context, cognitive style can be considered somewhat related to Guilford's 'dimension of intellect'. Where Guilford's model is a Cartesian project of three sets that represent intellect, content and things, the Cartesian project designed to represent cognitive style is composed of the following four sets: 1) symbols and meaning, 2) cultural determinants of the meaning of symbols, 3) modialities of inference, and 4) neurological, electrochemical and biochemical aspects of memory functions." (Hill 1970)

Since data on the various facets of memory are still incomplete, Hill had to settle for the first three sets as the basis for the cognitive style model.

Cognitive Style (After Hill, 1970)

Figure 1.

$$\left\{ \left\{ \text{Symbols and Meanings} \right\} \times \left\{ \text{Cultural Determinants} \right\} \times \left\{ \text{Modalities of Inference} \right\} \right\}$$

Martens (1975), who studied the Hill model extensively, has summarized its workings as follows:

> Each set in this model is composed of a series of elements which interact with elements in the other sets fo form the individual's cognitive style. In the first set symbols have been defined as something which stands for something else. The elements include two types of symbols; theoretical and qualitative. Theoretical symbols are those which have more generalized meaning in our society--words and numbers. Symbols from which individuals develop more personalized meanings are called qualitative. They derive their meaning from three areas, sensory data, humanly constructed formalisms such as games and programmatic effects of objects which convey an impression of images, scenes, events or operations. Symbols are modified by each individual according to his cultural background or cultural determinants of meaning. The three major determinants are family influences, associates of friends and an individual's own personal assessment. After symbols are modified by cultural determinants, the individual makes tentative conclusions about their meaning based on his characteristic thought processes. These processes, shown as modalities of inference, may be either inductive or deductive.

This model was used by Hill to systematically produce a map of how a student preferred to learn. Hill and his associates could then take the map and in consultation with each student prescribe a series of individual and/or group experiences which would optimize the students' probability for having successful learning experiences. Although Dr. Hill is now deceased, his set of scales have been used widely, especially in community colleges, to produce cognitive style maps which have been used to take advantage of individuals' strengths and augment their skills in areas of weakness (Nunney, 1977).

Origins and Characteristics of Cognitive Style: What Research Says

By now, sufficient studies have been performed in developmental and cross-cultural psychology which have suggested certain conclusions about the origins and significant properties of cognitive styles.

Stability. Lynna and Floyd Ausburn (1978, 337-354) report that one important aspect of cognitive styles is their generality and stability over time and across tasks. Although there is a natural development trend in all children from field dependence to field independence which continues to puberty (Abraham, 1978), relative cognitive style tends to remain stable over time. This means that individuals who are tested near puberty, and who demonstrate certain cognitive styles should demonstrate similar characteristics as they enter post-secondary education.

Related to the stability of cognitive styles is the apparent general resistance of certain styles to training and change. Such cognitive characteristics as field independence/dependence, cognitive tempo, and visual/haptic perceptual type appear to be deeply ingrained in individuals.

Witkin and Berry (1975) report the results of a number of cross-cultural studies which suggest that societal child-rearing practices play a large role in determining an individual's style along the dimension of field independence/dependence. They report findings that suggest if a child grows up in a society which encourages him to identify with an extended family or some other form of "shared-function" group, he will likely not move as far along the dimension toward field independence as the child who is encouraged to become independent of others at an early age. The same tendencies can be seen within the family: strict disciplinary practices and authoritarian parents who maintain close family connections tend to produce field-dependent children, whereas parents who do not enforce strict control over their children tend to produce field-independent children. Along these same lines, investigations have shown that in cultures of hunters and gatherers, who are typically migratory and who typically works alone, field independence is the predominant style, whereas in agrarian societies, where people must work together, most people tend to be field dependent.

The influence of group socialization practices was demonstrated in the early 1960's by J.L.M. Dawson (1963, 67) during his work in Sierra Leone, West Africa. He found greater field dependence among the people of the Temne tribe than among the members of the Mende groups. He discovered that the same relationships articulated by Witkin about group socialization practices were evident in the cognitive style profiles of the West African tribes. Among the characteristics of Temne socialization were stress on conformity to adult authority, severe discipline, physical punishment, and maternal dominance in child rearing.

Within the United States, Witkin's cultural hypothesis also has been supported by studies (Berry, 1966; Dershowitz, 1971; Mebane & Johnson, 1970; Ramírez, Castañeda, & Herold, 1974; Witkin, Price-Williams, Bertini, Christiansen, Oltman, Ramírez, & Van Meel, 1974) that have shown that cultural groups which stress traditional social values are more field dependent than American or Americanized groups in which these values are less rigidly enforced. Those studies also have found that members of traditional cultures who have been reared with Americanizing influences are less field dependent than members of the same culture who have not been subjected to this influence. Specifically, differences in learning and incentive-motivational styles between Mexican-American and Anglo-American groups are the end result of different socialization practices and the teachings of the mother. That is, because these cultural groups value characteristics that promote one type of learning behavior over another, members of these groups, on the average, tend to be oriented toward the learning behavior preferred or valued by the group. Gay (1978) reports that nearly all minority children in the United States are field dependent.

As a result, according to Ramírez, Castañeda, and Herrold (1974), students come to school equipped with preferred modes of learning, modes of learning resulting from the child's cultural milieu and the teaching style primarily of

the mother (see Laosa, 1978). As Gay (1978) and Cohen (1969) point out, these children are almost certain to be at a disadvantage when they enter a typical American school which places high value on analytical skills.

A corollary or extension to the above hypothesis is that within cultural groups (e.g., Mexican-Americans), differences can be found which correspond to one's degree of identification with traditional ethnic group cultural values on the one hand, and one's degree of assimilation of Anglo-American cultural values on the other (Ramírez, Castañeda & Herold, 1974; Castañeda, 1976). Thus, it has also been argued that cognitive style varies with degree of assimilation to the Anglo-American mainstream culture, with traditional, dualistic and assimilated cultural groups representing greater "differentiation" or field independence respectively (see Laosa, 1978; Ramírez et al., 1974).

Because of this apparent disparity, there have been those, such as Ramírez and Gay who urge that changes be made in the academic environments to accomodate the less assimilated, more traditional cultural groups. However, Hsi and Lim (1977) state that Chinese-Americans and Japanese-Americans are equal to or at times even surpass Anglo-American children in mathematics and reasoning skills, and warn against treating all minorities in the same manner.

Taken in their totality, the bulk of the studies on cognitive style may be interpreted as providing evidence consistent with the position that cultural differences are a primary source or "cause" of group differences in cognitive style, and hence group differences in achievement. However, in a recent study, De Avila and Duncan (1979) call for a more cautious interpretation of the literature based on the fact that much of the research cited in the literature is dependent upon the findings of corresponding group differences in field dependence/independence with group differences in "cultural values". They refer their audience to several cross-cultural studies which warn against the

interpretation of anything more than a mere coincidental relationship between corresponding differences in group means (e.g., Cole, 1975; Mercer, 1973, 1975; Rosch, 1975; Scribner, 1974; Scribner & Cole, 1973; Ginsburg & Koslowski, 1976; De Avila, Duncan, Ulibarrí & Fleming, 1979).

Despite the caveats mentioned above, cross-cultural research into individual cognitive styles has many implications for education. Triandis (1980) has summarized some of the important findings and the resulting implications as follows:

> Briefly, high differentiation (field independence) enables individuals to solve those probelms which require that some critical element be taken out of context and the problem material restructured so that the item is used in a different context. High differentiators have a separate identity from other persons, and they tend to use intellectualization as a typical defense mechanism, while low differentiators (field dependents) tend to use repression. The decade (from 1970-1980) has confirmed the basic elements of the theory. It has shown that ecology, social structure, conformity, and biology make some contributions to psychological differentiation (cognitive styles) and has further clarified the implications of being high as opposed to low in psychological differentiation. Perhaps the major implication that was clarified during the recent decade was that being "high" in differentiation (i.e., field independent) is not necessarily "good." It depends on the environment, the task, and the culture. While high differentiation (being field independent) is good for a mechanic, it is not good for a salesperson; while it is good when the task requires analysis, it is not good when it requires synthesis; while it is good when the emphasis is on "things," it is not good when the emphasis is on interpersonal sensitivity. In societies in which dealing with things and with production are essential for survival, differentiation is desirable, but in societies in which human services are emphasized, it is not necessarily desirable. Thus, the most recent research period has added complexity to our conception by making psychological differentiation an orthogonal construct to attributes that are socially desirable.

However complex our concept of cognitive style may have grown, we had some questions that needed to be answered. Since we are constantly looking for ways to improve the educational setting for our multi-cultural student-

body, and since we had had previous positive experience with the Hill Model, we decided to investigate the effect of culture on the cognitive styles of Polynesians and Caucasian-Americans in a multi-cultural school setting. We wanted to test the Hill Scales to see if they would be a valid predictor of individual cognitive styles. In addition, we wanted to test the popular hypothesis that students come to school equipped with preferred modes of learning, modes of learning resulting from the child's cultural milieu and the teaching style primarily of the mother (Ramírez, Castañeda, et al., 1974; also see De Ávila and Duncan, 1979).

Method

Subjects

The participants in the pilot study came from the three sixth grade classes of a local elementary school. They were nearly equally distributed with regard to sex: 42 females and 48 males, totalling 90 students.

Procedures

Demographic data were collected separately. It was determined that subjects ranged in age from 10 years to 12 years old with 32 being 11 years of age. Their residency in the United States ranged from two months to 12 years. Seven different parental ethnic groups were defined: 26 students listed both parents as caucasian; 12 students listed their mother as caucasian and their father as Polynesian, Japanese or Chinese; 9 identified both parents as being Hawaiian; 8 as Hawaiian-Japanese, Hawaiian-Chinese, Hawaiian-Tongan or Hawaiian-Samoan; 9 listed both parents a Tongan; 17 as totally Samoan; and 9 as representing a mixture of non-Hawaiian Polynesians with South Asians. The first language spoken in the home was partitioned into four categories: English, Samoan, Tongan, and Fijian. Birthplaces

listed were: the Mainland (USA); Hawaii; American Samoa; Western Samoa; Tonga; New Zealand; Indonesia; Fiji; Canada; and Europe.

Data were then collected by having students respond to the Hill Scales of cognitive style called the Cognitive Style Mapping Questionnaire. Map scores were intercorrelated (the results of these intercorrelations are available from the authors). The results were analyzed using two procedures from the Statistical Package for Social Sciences (SPSS): factor analysis with varimax rotation and analysis of variance.

Instrument

Dr. Joseph E. Hill and his associates created twenty-eight factors which serve to define a student's cognitive style. There is a corresponding questionnaire consisting of 224 scales which are used to elicit responses on an answer sheet which, when arithmetically tabulated and plotted on an accompanying graph, constitute a map of one's cognitive style. In order to enhance instrument reliability, the researchers revised the original Hill scales so they would be culturally appropriate. For example, the stimulus reference to the smell of a new car was replaced by contrasting the difference in the smell of fresh fruit with that of stale fruit because a majority of subjects have never smelled a new car before.

Results

Table 1 presents the results obtained from the Hill Cognitive Style Questionnaire. It may be observed that mean scores range from 23 to 31 from within a possible range of 14--considered negligibl a value of 40 whic is considered to be a major factor in a person's cognitive style.

Insert Table 1 About Here

One can also observe relatively high estimates of communality which raises the question of construct validity of the Hill scales (see also Stiggins, 1977 for the American College Testing Program's study of the Hill Model). Table 2 lists the results of the Varimax Rotation of the Cognitive Style scores. The loadings under Factor 1 show that age has a positive relation to three other factors: "QP"--coordination of thoughts or actions; "QCKH"--use of physical activity; and "K"--reasoning by deduction.

Insert Table 2 About Here

The highest loadings--above 0.30--for factor 2--"sex" are: "TVQ"--number relations by sight; and "QV"--input by sight. Factor 3--"race" demonstrated a strong negative loading on sex but no other loadings above 0.30 that were positive. When correlated with race, acculturation--factor 4--loaded positively on "TAL"--language input by hearing. The students showed a lower preference for the other component of factor 4: "QV"--input by sight. Factor 5--"first language spoken in the home" also shows a dual-component loading pattern. Students most highly preferred "QO"--input by smell; but they also responded to "QCEM"--awareness of the feelings of others. Factor

Table 1.--Means, Standard Deviations, Estimated Communality Values, and Eigenvalues for Cognitive Style Scores of Sixth Grade Students

VARIABLES..	LABELS..	MEAN	STANDARD DEV	CASES	COMMUNALITY	FACTOR	EIGENVALUE
AGE		11.2148	0.3850	90	0.54954	1	9.94413
SEX				90	0.71224	2	2.10604
RACE				90	0.92145	3	1.98742
ACCULTR	ACCULTURATION	8.9509	3.7460	90	0.86830	4	1.50139
LANG1	FIRST LANGUAGE IN HOME			90	0.77071	5	1.29039
BRTHPLC	BIRTH PLACE			90	0.69415	6	1.10122
TAL	LANGUAGE INPUT BY HEARING	28.6222	4.3203	90	0.97968	7	1.00003
TAQ	NUMBER RELATIONS BY HEARING	25.8000	4.6837	90	0.88421	8	0.93304
TVL	LANGUAGE INPUT BY SIGHT	27.0444	4.7141	90	0.74435	9	0.86936
TVQ	NUMBER RELATIONS BY SIGHT	28.7444	4.0377	90	0.84999	10	0.74169
QA	INPUT BY SOUND	20.1778	4.6218	90	0.72020	11	0.70905
QO	INPUT BY SMELL	27.0111	5.2328	90	0.88882	12	0.68137
QS	INPUT BY TASTE	20.4444	4.9244	90	0.85809	13	0.66289
QT	INPUT BY TOUCH	29.8222	5.1012	90	0.90449	14	0.58858
QV	INPUT BY SIGHT	20.6222	4.9532	90	0.75737	15	0.56006
QP	COORDINATION OF THOUGHTS OR ACTIONS	27.8222	5.8494	90	0.90039	16	0.51245
QCEM	AWARENESS OF FEELINGS OF OTHERS	27.4444	5.0081	90	0.97425	17	0.45635
QCES	ENJOYMENT OF BEAUTY	28.4222	5.2744	90	0.86070	18	0.40313
QCET	COMMITMENT TO PRINCIPLES	29.3333	4.8621	90	0.86374	19	0.38742
QCH	SENSE OF THE DRAMATIC	26.1111	4.8097	90	0.85256	20	0.33767
QCK	USE OF NONVERBAL LANGUAGE	24.9778	5.1864	90	0.70075	21	0.29107
QCKH	USE OF PHYSICAL ACTIVITY	27.3778	5.2587	90	0.99223	22	0.27278
QCP	KNOWLEDGE OF PROPER SOCIAL DISTANCE	27.2889	5.2472	90	0.97807	23	0.21183
QCS	KNOWLEDGE OF SELF	29.0000	5.7534	90	0.98703	24	0.10052
QCT	USE OF PERSUASION	25.4889	5.9099	90	0.85701	25	0.15701
QCTM	AWARENESS OF TIME	28.5111	4.6806	90	0.85712	26	0.12410
A	WORKING WITH FRIENDS	29.0889	4.7039	90	0.77850	27	0.10919
F	WORKING WITH DIRECTION	28.9778	4.9195	90	0.89516	28	0.08603
I	WORKING INDEPENDENTLY	25.8889	4.2332	90	0.67005	29	0.07704
M	REASONING BY APPLYING RULES	30.5111	4.6113	90	0.73468	30	0.05277
D	REASONING BY LOOKING FOR DIFFERE	27.9778	4.8667	90	0.62605	31	0.01692
R	REASONING BY LOOKING FOR SIMILARITIES	26.4444	5.3530	90	0.83178	32	0.00396
L	REASONING BY WEIGHING ALL FACTORS	27.3111	4.6752	90	0.91234	33	0.00044
K	REASONING BY DEDUCTION	27.8444	5.9138	90	0.97946	34	-0.00547

Table 2.

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
AGE	0.04335	0.00712	0.13728	0.05064	-0.02786	0.02638	0.01948	0.04237	0.00419	0.01914
SEX	-0.04178	-0.11883	-0.78238	-0.04456	0.03685	0.05410	0.04328	0.03003	0.03844	0.05308
RACE	-0.09369	-0.05635	0.09106	-0.03474	-0.01687	-0.86797	0.00715	0.00809	-0.05704	-0.07513
ACCULTR	-0.00114	-0.00739	0.09526	0.02777	-0.00735	0.26911	0.12222	-0.01273	-0.00768	0.07903
LANG1	-0.06767	0.04248	-0.02753	-0.07340	0.03965	-0.16321	-0.01187	0.01564	-0.04789	-0.10019
BRTHPLC	-0.00495	-0.05041	-0.07529	0.02659	-0.09163	-0.10694	-0.03236	-0.07006	-0.05893	0.06787
TAL	0.05499	0.04455	0.05607	0.86452	0.15351	0.09073	0.13104	0.10245	0.03025	0.07314
TAQ	0.16476	0.14166	0.20476	0.17853	0.12212	-0.08041	0.05018	0.16305	0.14363	0.15309
TVL	0.06708	0.20342	0.00150	-0.01178	0.01629	0.06218	0.21409	0.05036	0.01687	0.02248
TVQ	0.03594	0.83444	0.13609	0.03742	-0.01547	0.09732	0.09226	0.06239	0.04797	0.00466
QA	0.09509	0.00792	-0.06093	0.08589	0.07476	0.10743	0.01556	-0.03649	0.13017	0.79729
QD	0.10470	-0.01697	-0.03978	0.13083	0.84220	0.00781	0.06805	0.02594	0.09420	0.07767
QS	0.03419	0.08062	-0.07324	0.04158	0.12546	0.12212	0.10308	0.16793	0.73906	0.17809
QT	0.16797	-0.02158	0.17685	0.26200	0.16156	0.16343	0.26721	0.28100	0.31565	0.15053
QV	0.07143	0.34008	0.03934	0.34399	-0.00064	0.00986	0.03865	0.10608	0.09352	0.01602
QP	0.72776	0.05597	0.05071	0.02579	0.18105	0.21609	0.12883	0.17476	0.05066	0.11757
QCEM	0.07460	-0.01470	-0.12351	0.09120	0.33626	0.21245	0.29582	0.19450	0.01153	0.35557
QCES	0.11199	0.08089	-0.04546	0.10370	0.02969	0.01394	0.08020	0.80667	0.12974	-0.03406
QCET	0.16164	0.15093	0.04763	0.15971	0.01040	0.53886	0.19333	0.07552	0.12919	0.13224
QCH	0.14218	0.01414	0.06028	0.06109	0.06946	0.01094	-0.03865	0.01511	0.16115	0.14703
QCK	0.07555	-0.02094	0.03613	0.20012	0.14378	0.15209	0.01878	0.03983	0.07920	0.11134
QCKH	0.49667	0.10292	0.18773	0.25784	-0.06445	-0.01033	0.14858	0.00711	0.22366	0.19592
QCP	0.26809	0.11143	0.14682	0.05732	0.21439	0.26664	0.08380	0.29080	0.10853	0.27688
QCS	0.19000	0.27364	0.08638	0.10006	0.04084	0.43010	0.21944	0.16829	0.08965	0.19116
QCT	0.15183	-0.06088	-0.02947	-0.04356	0.06411	0.13104	0.12117	0.11536	0.01515	0.12562
QCTM	0.04724	0.16897	-0.07771	0.11873	0.25524	0.21726	-0.02884	0.14009	0.12212	0.16189
A	0.05128	0.20313	0.06562	0.24940	0.07501	0.01136	0.13048	0.18980	0.19235	0.10567
F	0.09706	0.10844	-0.05725	0.11954	0.07029	0.04164	0.84079	0.08277	0.08215	0.01803
I	0.02631	0.10363	-0.00448	-0.02954	0.14153	0.02973	0.02625	0.07971	0.06549	0.01427
M	0.06955	0.07834	-0.06006	0.05035	0.09530	0.07764	0.10513	0.15082	0.04096	0.03932
D	0.13291	0.17671	0.08589	0.11767	0.05189	0.10705	0.11880	0.15686	0.06022	0.08151
R	0.08707	0.10038	0.11629	-0.01092	0.12813	-0.00023	0.09245	0.13542	0.11706	0.19659
L	0.04881	-0.03197	0.14671	0.16976	0.18457	0.09786	0.23894	0.11212	0.04889	0.13787
K	0.36033	-0.06157	-0.07319	0.14163	0.09233	0.25744	-0.00890	0.05439	0.12489	0.02167

Table 2 cont'd

	FACTOR 11	FACTOR 12	FACTOR 13	FACTOR 14	FACTOR 15	FACTOR 16	FACTOR 17	FACTOR 18	FACTOR 19	FACTOR 20
AGE	0.05607	0.01787	0.71004	0.04094	-0.04212	-0.03080	-0.01146	0.01250	0.01300	-0.04099
SEX	-0.04324	0.02870	-0.17724	0.02268	-0.04058	0.00298	-0.05235	-0.03318	-0.06251	-0.06435
RACE	-0.15076	0.23148	-0.05596	-0.08486	-0.03961	0.00479	-0.01438	-0.09308	-0.07343	-0.05072
AGTOLTR	0.60067	-0.22858	0.15976	-0.00273	0.03309	-0.01654	-0.05128	0.07087	0.09894	0.05136
LANGI	-0.09548	0.81204	0.02617	0.00546	0.01707	-0.07630	0.02473	0.05728	-0.01894	-0.02666
ERTHPLC	-0.12571	0.15682	-0.06016	-0.01230	-0.00840	-0.02481	-0.04394	-0.01001	-0.05573	-0.01386
TAL	0.03927	-0.11727	0.08933	-0.05204	0.01498	-0.04827	0.07271	0.22815	0.11133	0.09531
TAQ	0.11481	0.01560	-0.01973	0.11375	0.18774	0.09708	0.17077	0.21029	0.18721	0.10207
TVL	0.07778	-0.04608	-0.05759	-0.10193	0.03304	0.12140	-0.00290	0.03220	0.11782	0.12989
TVQ	-0.01558	0.04020	0.00858	-0.05956	0.02495	0.11447	0.00955	-0.01735	0.13639	-0.02052
GA	0.04095	-0.12146	0.02703	0.10441	0.11067	0.01389	0.14769	0.11678	0.06525	0.07691
GD	-0.00829	0.05040	-0.04920	0.05443	0.09678	0.16904	0.07560	0.14659	0.03531	0.09703
GE	-0.00533	-0.00926	0.00939	0.01840	0.14575	0.11169	0.25297	0.10792	0.06959	0.03228
GT	0.15795	0.09817	-0.05837	0.05306	0.07879	0.11835	-0.01646	0.16925	0.19358	0.11857
GV	0.21835	0.09000	0.02467	0.11333	0.23744	0.10290	0.04268	-0.00362	0.01685	0.09468
GP	0.02619	-0.15218	0.08726	0.17338	0.16046	0.00723	0.22266	0.09644	0.14085	0.00248
GCEM	0.06230	0.00434	0.00234	0.06388	0.21518	0.09601	0.10972	0.03286	0.15546	0.05616
GCES	-0.01054	0.02176	0.07502	0.10777	0.10195	0.10299	0.02049	0.04452	0.13345	0.06004
GCET	-0.05912	0.06886	-0.10219	0.08488	0.06265	0.14064	-0.02429	0.20498	0.03570	0.04420
GCH	-0.02908	0.03354	-0.02033	0.14640	0.14621	0.13577	0.82769	0.08225	0.01561	0.04738
GCA	0.04437	0.06044	0.02151	0.11516	0.10678	0.05089	0.07910	0.72408	0.05339	0.06068
GCKH	-0.10095	0.10364	0.08431	0.11401	0.21124	0.29410	0.05388	0.21023	0.30030	0.17521
GCP	0.12973	-0.13654	-0.11084	0.22667	0.18134	0.04938	0.13858	0.06976	0.17143	-0.02702
GCS	0.12950	0.02845	0.07901	0.24673	0.13466	0.10904	0.21573	0.24410	0.11668	-0.02195
GCT	-0.00058	0.00811	0.06965	0.78069	0.14164	0.15061	0.17486	0.13846	0.09336	0.06046
GCTM	0.07862	-0.11530	0.04145	0.14783	0.09752	0.11464	-0.07969	0.11162	0.14331	0.15067
A	-0.05200	0.00198	-0.01177	0.00735	0.18274	-0.10599	0.02475	0.10937	0.09721	0.12776
F	0.06728	-0.01919	0.03273	0.10869	0.05111	0.02998	-0.03962	0.02139	0.10020	0.12693
I	-0.00200	-0.07659	-0.04101	0.10923	0.05749	0.75104	0.11251	0.04285	0.06802	0.01649
M	-0.05111	-0.06165	-0.06284	-0.02659	0.06485	0.00438	-0.00210	-0.01650	0.02245	0.09692
D	0.07079	-0.03717	0.02504	0.09163	0.09805	0.09557	0.01546	0.06305	0.62957	0.04393
R	0.02356	0.04436	-0.11035	0.09207	0.69163	0.13733	0.12418	0.25886	0.21647	-0.01231
L	0.05594	-0.05832	-0.13949	0.10662	0.05565	0.03907	0.09195	0.10777	0.06825	0.70415
K	0.02364	-0.03948	0.00440	0.25552	0.63134	-0.02947	0.29558	-0.09146	-0.10723	0.13054

Table 2 cont'd

	FACTOR 21	FACTOR 22	FACTOR 23	FACTOR 24	FACTOR 25	FACTOR 26	FACTOR 27	FACTOR 28	FACTOR 29	FACTOR 30
AGE	0.05413	0.01548	-0.64846	-0.00465	-0.01721	0.00626	0.00094	-0.03459	-0.00547	-0.00631
SEX	-0.00032	0.03588	0.04966	-0.06712	-0.03437	-0.00703	0.01547	-0.06644	-0.03515	-0.02717
RACE	-0.10662	-0.08088	-0.03867	0.02656	-0.06837	-0.01135	0.00086	-0.04304	0.00121	-0.04407
ACCULTR	0.37159	0.07433	-0.11239	0.09123	0.05229	0.02286	0.01540	0.16327	-0.06016	0.04086
LANG1	-0.17376	-0.04911	-0.04819	0.00640	-0.02591	0.00219	0.00167	-0.02645	0.00048	0.01810
BRTHPLC	-0.77128	-0.05742	-0.00320	-0.00157	-0.00436	-0.00874	-0.01663	0.00429	0.04157	-0.02333
TAL	-0.03428	0.07660	0.07184	0.09218	0.01459	0.02141	0.00951	-0.00178	0.15867	0.03493
TAG	0.04513	0.02934	0.15872	0.64168	0.01532	0.02093	0.05298	0.04551	0.17400	0.05282
TVI	0.00675	0.04819	0.13960	0.02487	0.01923	0.02195	-0.02319	0.73770	-0.00199	0.01978
TVG	0.05756	0.07957	0.00905	0.05777	0.02617	0.02651	-0.00951	0.18371	0.11276	-0.01169
GA	-0.08784	0.07759	0.05083	0.06353	0.06472	0.01584	0.03006	0.02675	0.06558	0.02715
GO	0.10572	0.11976	0.09704	0.05287	0.04960	0.00286	0.03115	0.01834	0.04949	0.03064
GS	0.09249	0.09136	0.07792	0.08426	0.04085	0.00921	0.00691	0.02911	0.17308	0.05725
GT	0.18680	0.03162	0.09954	0.13677	0.14695	0.04423	-0.03558	0.19171	-0.03073	0.58170
GV	-0.01120	0.01871	0.22633	-0.00883	0.09570	-0.16601	0.14874	0.37458	0.13928	0.21708
GP	-0.01957	0.05067	0.14059	0.07606	0.05081	0.00573	0.00900	0.09731	0.05049	0.02428
GCEM	0.13610	0.26174	0.24805	0.18538	0.05646	0.04914	0.46087	-0.06114	0.10181	-0.02751
GCES	0.08093	0.08036	0.19575	0.07667	0.06666	0.01567	0.03219	0.06076	0.13144	0.04503
GCET	0.15444	0.09461	0.43730	-0.05450	-0.00127	-0.01363	0.11010	0.05294	0.06920	-0.07641
GCH	0.04614	-0.04362	-0.00777	0.07055	0.03516	0.01741	0.01564	-0.00374	0.01748	-0.00293
GCK	0.01474	0.05810	0.00166	0.08572	0.02414	0.01821	0.00424	0.03002	0.06852	0.02904
GCKH	0.13243	-0.06048	0.05347	0.13581	0.27485	0.10610	0.03620	0.01376	0.04713	0.10719
GCP	0.01602	0.13355	0.12648	0.01837	0.57157	-0.01816	0.03155	0.09659	0.05067	0.09323
GCS	0.11067	0.07394	0.32425	0.08897	-0.01682	0.40318	0.08382	0.07181	-0.03933	0.06084
GCT	0.01549	0.08678	-0.01763	0.05899	0.06640	0.02056	0.01238	-0.09974	0.00798	0.01857
GCTM	0.14084	0.66193	0.17342	0.02359	0.06092	0.01170	0.05744	0.09493	-0.00018	0.01393
A	-0.09161	0.00123	0.10315	0.11751	0.02246	-0.00845	0.02547	0.01987	0.66345	-0.00565
F	0.04332	-0.01747	0.14072	0.01967	0.02723	0.01738	0.03486	0.21159	0.08799	0.04427
I	0.02094	0.05308	0.02151	0.03371	0.01329	0.00665	0.01350	0.10287	-0.05229	0.01975
M	-0.02579	0.07181	0.77830	0.07153	0.03446	0.01742	0.01667	0.13152	0.05587	0.02786
D	0.08588	0.09642	0.03312	0.09182	0.05366	0.01108	0.02730	0.13811	0.07553	0.03717
R	0.02730	0.04241	0.07780	0.03554	0.04345	0.03192	0.01806	-0.00245	0.19635	0.01754
L	0.03595	0.14359	0.20403	0.08651	-0.00556	-0.00569	0.01749	0.25605	0.15014	0.04161
K	-0.01074	0.10221	0.10772	0.24052	0.08231	-0.01597	0.06371	0.17810	0.00560	0.02565

6--"Birthplace" shows that "QCET"--commitment to principles, "QCS"--knowledge of self, and race are three components of a bipolar scale which may be designated as "QCET plus QCS minus race." Interestingly, "M"--reasoning by applying rules, replaces race for factor 23--"knowledge of social distance," a factor strongly attended to in the mainstream culture. Apparently when 6th-grade students prefer to learn by listening, they also prefer to work under direction. Factor 7 shows a high loading for "F." Those younsters who prefer to learn their number relations by hearing (TAG-Factor 8), also have a keen enjoyment of beauty (QCES). Factor 9: "TVL" --language input by sight, demonstrates that students with a preference for learning by reading also prefer to experience their environment by tasting and touching it. "QS"--input by taste, and "QT"--input by touch, are seen to be two positive components of factor 9. Factor 10: "number relations by sight," also shows a dual-component loading. Apparently the majority of the students prefer listening to music while studying mathematics, because the highest loading is seen to be for "QA"--input by sound. Surprisingly, the other components is "QCEM"--awareness of the feelings of others. Factor 11: "QA"--input by sound, shows a positive loading for acculturation--i.e, the length of time a student has been in the United States. Those students who demonstrated a strong preference for factor 12: "QO"--input by smell, also speak some other language besides English in the home (factor 5). The loading factor 13: "QS"--input by taste, depends upon the age of the student (factor 1). Factor 14: "QT"--input by touch, shows the highest loading for factor 25--use of persuasion. Factor 15: "QV"--input by sight shows that there are two components, "R"--reasoning by looking for similarities, and "K"--reasoning by deduction. Interestingly, when the vectors of age, factor 1, and input by sight, factor 15, share "K" (factor 34) as a common component. Students who show a

a high preference to coordinate thoughts and actions--"QP" factor 16, tend also to prefer to work independently--"I"--factor 29. Factor 17: "QCEM" --awareness of the feelings of others, shows that students who have this ability also tend to have a sense of the dramatic--factor 20. Factor 18: "QCES"--enjoyment of beauty, shows a high loading for factor 21--use of nonverbal language. Factor 19: "QCET"--commitment to principles, loads most strongly on factor 31--reasoning by looking for differences. Factor 20: "QCH" --sense of the dramatic is preferred by those who also reason by weighing all factors--factor 33. Factor 21: "QCK"--use of non-verbal language, is a bi-polar scale with two components: factor--acculturation, and factor 6--birthplace. Factor 22: "QCKT"--use of physical activity, loads most strongly with factor 26--awareness of time. Factor 23: "QCP"--knowledge of proper social distance, shows that this factor has three components: factor 30--reasoning by applying rules; factor 19--commitment to principles; and factor 24--knowledge of self. This same factor, Factor 24 shows a high loading for factor 8--number relations by hearing. Factor 25: "QCT"--demonstrates a student performance on factor 23--knowledge of proper social distance. Loading on factor 26: "QCTM"--awareness of time, was highest for factor 24--knowledge of self which also loaded on factor 23. Factor 27: "A"--working together with friends, is related as one would expect to factor 17--awareness of the feelings of others. Factor 28: "F"--working under direction appears to be closely related to factor 9--language input by sight. Factor 29: "I"--working independently, shares the concept "work" with factor 27--working with friends. Factor 30: "M"--reasoning by applying rules, shows highest loading on factor 14--input by touch. Factor 31: "D"--reasoning by looking for differences, factor 32: "R"--reasoning by looking for similarities, factor 33: "L"--reasoning by weighing all factors, and factor 34: "K"--reasoning by deduction, are not presented because none demonstrated loadings above 0.30.

To decide whether the magnitude of the differences between cultural group means on cognitive variables was sufficiently large to account for significant variance, one-way analysis of variance tests for randomized designs were calculated. The Scheffé post hoc procedure of multiple range comparisons was applied to determine significant differences between group means. The .05 alpha level was adopted for a critierion of rejection of no intergroup variance. Each cultural group was compared statistically with every other cultural group in the sample. The results were categorized by race and by languages. Of the 28 cognitive variables that were compared by race between cultures only five variables were significant at the 0.05 level, v12., commitment to principles, knowledge of self, knowledge of proper social distance, awareness of time and working independently. A summary of these results is cited in Table 3 and 4.

Table 3--Mean Significant Differences in cognitive styles by race*

1. Commitment to Principles

Cultures FD*		Cultures FI	
Tongan	26.22	Caucasian	33.23
Mixed	26.44		
Samoan	26.71		
Hawaiian	28.00		

2. Knowledge of Self

Cultures FD		Cultures FI	
Tongan	24.67	Caucasian	33.23
Samoan	25.42		
Hawaiian	26.75		
Mixed	26.89		

3. Awareness of Time

Cultures FD		Cultures FI	
Tongan	25.78	Caucasian	31.77
Samoan	26.35		

4. Knowledge of proper social distance

Culture FD		Culture FI	
Samoan	24.00	Caucasian	30.15
Mixed	24.89		

5. Working Independently

Culture FD		Culture FI	
Hawaiian	22.80	Asian mixed	28.43

* Field Dependent Cultures differed significantly at p>.05 or better from Field Independent Cultures

Table 4--Mean Significant Differences in Cognitive Styles by Language

1. Working Independently		
Culture A		Culture B
Samoan 28.43		Tongan 22.80

$p > .05$

Conclusions

The research data appear to support Witkin's (1974) cultural hypothesis: children from cultures stressing social conformity and who live where social density is high will tend to be more field dependent (see also Berry and Annis, 1974), the warnings of De Avila and Duncan notwithstanding both the factor analysis and the analysis of variance demonstrated that when inter-group means are compared, sixth graders in a multi-cultural setting in Hawaii tend to demonstrate differing cognitive styles which they bring to the school setting as a result of each child's dominant family culture. Furthermore, the Hill scales seem to discriminate these differences--especially in field dependency/independency--along cultural lines. The caucasian group predominantly scored highest on scales suggesting field independency. And to the contrary, the Polynesian cultures (Tongan, Samoan and Hawaiian) exhibited what was interpreted as a field dependent profile with the Tongan group the most pronounced.

Paradoxically, the expectations on the language variable by culture was not supported. The Samoan group showed greatest preference for working independently. This trait is more commonly identified with field independence but may reflect here a cultural

group that has the most difficulty assimilating into the host culture.

The factor analysis for this pilot study demonstrated several significant cognitive style preferences. Developmentally in a multicultural setting sixth graders preferred most often to learn by listening and work under direction. This also may reflect the Polynesian learning styles where 56% of the sample were Polynesian. Additionally, the sixth graders demonstrated a high preference to listening to music while studying mathematics. The overall study identified no discrimination by sex.

Original designs to study acculturation according to race had to be abandoned in this pilot effort because of lack of power due to the small number of asians in the sample. Effects of acculturation and its relationship to field dependency/independency remains to be studied in samples where adequate numbers of asians are present.

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